INTERFACER 80

• USER'S MANUAL •

Input / Output
Interface for the
TRS-80®

Model I and Model III*

ALPHA Products

INTERFACER 80
USER'S MANUAL

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ALPHA Products

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ADDENDUM FOR MODEL III USERS

The Interfacer 80 and this manual were originally designed for the TRS-80 Model I. Before proceeding with this manual, please read this important information regarding interfacing with the Model III :

CONNECTION- In order to operate the Interfacer 80 on the Model III, a converter module is required (Alpha Products MOD III/I BUS CONVERTER). Refer to the instructions provided with the converter for connection of the Interfacer 80 to your TRS-80 Model III.

PROGRAMMING- As detailed in the MOD III/I BUS CONVERTER instructions, the Model III has a protective feature, an internal "disable" function. Before operating any external device such as the Interfacer 80, it is necessary to first "enable" the I/O section via the BASIC statement: OUT 236,16. The Model I TRS-80 did not require this enabling statement as it's I/O section was always "enabled".

The following is a list of changes that will enable each of the programs contained in this manual to run on the Model III. In each case, the program line(s) in the original listing should be replaced with the line(s) listed here :

Page#	Program	Line# / Change to:
13	Input Status	20 CLS:L=999:OUT 236,16 50 CLS:L=N:OUT236,16
15	Auto Dialer	10 CLS:PRINT CHR$(23):OUT 236,16

IMPORTANT NOTE:
I/O is also disabled after execution of any statement in the "Command Mode" (whenever READY appears, I/O has been disabled). Therefore, in the Model III command mode, OUT 236,16 must always precede any INP or OUT in the command statement line. For example on the bottom of page 5 we list this command statement :

OUT 0,4

For the Model III, this command line should be changed to :

OUT 236,16: OUT 0,4

Similarly, other OUT and IN examples given in the Testing the Inputs/ Outputs section require the insertion of OUT 236,16.

OPERATING INSTRUCTIONS

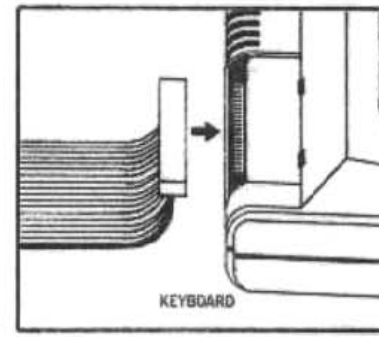
CONNECTION

Read carefully before making any connections.

1. Make certain power is off on both the Interfacer 80 and the TRS-80.

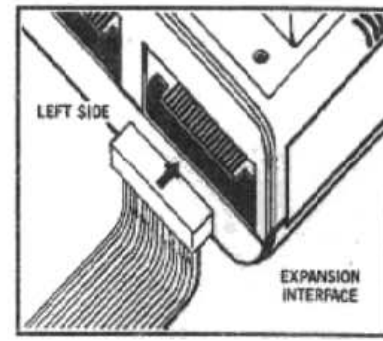
2. Locate the 40 pin edge connector on the left rear of the TRS-80's keyboard. If you have an Expansion Interface use the expansion connector on its left side panel to the right of the parallel printer port.

3. Plug the Interfacer 80's cable connector onto the proper TRS-80 connector as shown in one of the diagrams. Make certain that the ribbon cable comes out of the bottom of the connector.



4. Plug in the power supply for the Interfacer 80.

5. Turn on the TRS-80. If the TRS-80 behaves erratically kill all power immediately and double check connections.



OPERATING CAUTIONS

Damage to the Interfacer 80 and possibly the TRS-80 will result if the following cautions are not observed.

- Never connect any voltage higher than 25 VDC to any input.

- Never connect either side of an AC line to input terminals or to "GND", "A", or "V+" terminals.

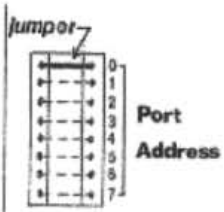
- We do not recommend that the relays be used to control 117 VAC unless extreme caution is taken to prevent accidental contact with wiring and terminal strips. If AC or heavy DC loads are to be switched, see "Load Switching Considerations" before any connections are made.

PORT SELECTION

The operating "port address" of the Interfacer 80 is jumper selectable. The Interfacer 80 has been set to Port 0 at the factory.

Altering the port address is only necessary when more than one port operated I/O device is being used on a TRS-80 system. Up to eight Interfacer 80's may be used together on a single system by selecting a different port address for each unit and addressing each one seperately.

To change the port address, move the single jumper in the socket located on the left side of the Interfacer 80 to the desired port number. Never put more than one jumper in the socket.



IMPORTANT NOTE! The explanations and programs in this manual assume the Interfacer 80 to be jumper programmed to Port 0.

UNDERSTANDING PORTS

A brief discussion of microcomputer ports and the 8-bit binary codes used for port operation will help you to better utilize the Interfacer 80.

The TRS-80 is built around a powerful microprocessor, the Zilog Z-80. The Z-80 has a total of 256 usable "ports" for input or output to external devices. These ports are numbered 0 to 255.

The Interfacer 80 uses a single one of these ports as determined by the port select jumper. In this manual we assume the Interfacer 80 to be jumper programed to Port 0 as it comes preset from the factory.

Port operations in the Z-80 utilize an "8-bit data bus" for inputting or outputting information. The term "8-bit" simply means that the port has 8 individual lines upon which information is either input to the computer, or output to an exernal device. These 8 lines are labeled D0-D7.

When an input to a port is performed, the computer reads the 8 parellel data lines D0-D7 simultaneously and interpretes them as a single 8-bit word of "byte" of information. Each one of the 8 individual data lines is read by the computer as either ON (logical 1) or OFF (logical 0).

Like all microprocessors, the TRS-80 uses the binary number system for internal processing of data. Those familiar with the binary number system know that it consists entirely of 0's and 1's, and that these 0's and 1's can also be considered OFF's and ON's respectively.

All input and output processing between the Interfacer 80 and the TRS-80 are in the form of 8-bit bytes. It should be understood that the Interfacer 80 makes available to the user the eight lines or "bits" that combined constitute a "byte" of information.

The 8-bit binary number 00000001 equals the number 1 in our decimal system. Likewise, 00000010 equals decimal 2 and 00000011 equals decimal 3. Those not familiar with binary numbers, are advised to pick up any microcomputer primer and read the chapter regarding number systems. A familirity with binary numbers will prove helpful in fully utilizing the Interfacer 80.

Each digit in a binary expression such as 00000001 represents one output relay or one input terminal.

THE OUTPUTS

When a port output (OUT) is performed in Level II Basic, the computer converts a user given decimal number to an 8-bit binary byte. The 8 bits are then momentarily output to the TRS-80 bus on data lines D0-D7, each line carrying a single "bit" of information. At that moment the Interfacer 80 takes a simultaneous reading of all 8 lines and latches this "information" onto its 8 relay drivers. Each relay corresponds directly to one of the data lines or "bits". This information in the form of "relays activated" (logical 1) and "relays not activated" (logical 0) remains latched until such time as the user or program executes a subsequent port output. Thus, control of the Interfacer 80 relays is provided.

Output relay control is accomplished by execution of the BASIC language OUT P,X statement, where P is the operating port # (assigned by jumper, see "Port Selection"), and X is a value representing which relays are to be activated. The value of X is termed the "data value" and can be any whole number in the range of 0-255 (inclusive).

The Data Value Table lists the value of X for each of the individual output relays.

The data value for relay #4 is 16. Therefore, assuming that the Interfacer 80 is assigned to port 0, the correct statement for activating relay #4 is:

```
OUT 0,16
```

Similarly, the following will turn on relay #2:

```
OUT 0,4
```

DATA VALUE TABLE

Relay#/ Input#	Data Value
0	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128

Besides using the Data Value Table, there is another way of determining the value of X. Refering back to our 8 bit binary expression, remember that each digit represents one of the output relays.

Consider the binary expression 00000001. Output relay #0 corresponds to the least significant (furthest to the right) digit of this 8-bit binary number. Conversely, relay #7 corresponds to the most significant (furthest to the left) digit. To turn on output relay 0 only, we must output the binary 00000001 which, of course, is equivalent to a decimal 1. The correct Level II Basic statement to accomplish this therefore is OUT 0,1. The statement OUT 0,1 instructs the TRS-80 to output the binary equivalent to a decimal 1 on PORT 0. The Interfacer 80 receives the binary code 00000001 and latches its output 0 relay on accordingly. If we read this binary code 00000001 from right to left we can see that the first line (D0) is a 1 and, therefore, ON and the other seven lines (D1-D7) are 0's and, therefore, OFF. This is exactly how the Interfacer 80 will latch its relays. Thus there is a direct correlation between each output relay and a bit position within the 8-bit binary byte.

Suppose you wish to activate relay #3 only. Then the fourth digit to the left in your binary expression should be a 1, representing ON for the fourth bit (relay #3 is actually the "fourth" relay since there is a relay # 0). The binary 00001000 equals decimal 8, so to turn on output #3, use OUT 0,8.

Another simple way of determing the "data value" to use in your OUT statement is the "Powers of Two" method. To find your data value raise 2 to the power of the output relay # that you want to energize - some examples:

To turn on relay #3, use OUT 0,8 because $2^3 = 2x2x2 = 8$
To turn on relay #0, use OUT 0,1 because $2^0 = 1$.
To turn on relay #5, use OUT 0,32 because $2^5 = 2x2x2x2x2 = 32$.

Of course, you may wish to turn on two or more relays at once. To do this, add the data values of the relays that you want on together - for example:

To turn on relay #2 and #3 add 2^2 and $2^3 = 4 + 8 = 12$. An OUT 0,12 will turn on both relays.

To turn off all relays at once, use the statement OUT 0,0.

To turn off particular outputs, merely output that which you want to remain on, as in the following example:

Suppose you had turned relays 2 and 3 on by executing an OUT 0,12 and now you wished to turn off relay 2 but leave relay 3 on. Simply output that which you want to remain on. In this case, use OUT 0,8 thus leaving on relay 3 but turning off relay 2.

This brings up an important rule in using the Interfacer 80: Each succeeding OUT statement overrules the previous OUT statement. In other words, every OUT statement commands all eight relays.

INPUT OR OUTPUT #	DATA VALUE	BINARY NUMBER
Ø	1	00000001
1	2	00000010
2	4	00000100
3	8	00001000
4	16	00 000
5	32	00 0000
6	64	01000000
7	128	10000000

DATA VALUE TABLE

THE INPUTS

Inputting is similar to outputting except that, of course, the computer is sensing inputs rather than commanding outputs.

Inputs are accomplished via the Level II Basic statement INP(P), where P is the jumper selected port assignment of the Interface 80. Assuming port 0 is used, the statement becomes INP(0). Each time INP(0) is executed, the TRS-80 reads all eight input lines of the Interfacer 80 and returns a decimal value representing the status of the eight input terminals.

If an input is high (voltage present) it is considered a logical 1. Conversely, an input that is low or grounded is read as logical 0. Due to the nature of TTL logic, an input which is left unconnected will "float high" and be seen as a logical 1. Therefore, if you enter the statement: PRINT INP(0) with nothing connected to any of the 8 inputs, the computer will display the value 255. This means that all 8 inputs are high or "ON".

The way to determine which inputs are pulled low is by subtracting the value of INP(0) from 255. The result is the decimal equivalent of the binary sum of all grounded inputs. For example:

If INP(0) returns a value of 254 ... 255 - 254 = 1

Therefore only input 0 was low. We know this because the data value 1 corresponds with input # 0. Had the result of INP(0) been 252, then:

255 - 252 = 3 = binary 00000011

This indicates that inputs 0 and 1 only were grounded. Another example:

INP (0) = 243 255 - 243 = 12 = binary 00001100,

This indicates that inputs 2 and 3 are connected to ground.

A program that automatically subtracts and decodes the inputs is given in this manual under User Programs.

TESTING THE OUTPUTS

For testing purposes, the Interfacer 80 should be jumper programmed to operate on port 0. Output relay control is accomplished by execution of the OUT P,X statement, where P is the operating port # and X is "data value" value to be output. The microcomputer converts the value of X to an 8-bit binary number and then outputs these eight bits to the 8 relays of the Interfacer 80. The Interfacer 80 latches the 8 relays until a subsequent OUT 0,X is performed.

The tests that follow are all performed in the TRS-80 "command mode" (i.e. "READY >" appears on screen). Model III users must place the statement OUT 236,16: immediately before each of the statements below in order to activate the Model III I/O section. For example if the test statement reads OUT 0,2 below, Model III users should type OUT 236,16:OUT 0,2. This is not necessary for Model I users as the I/O section in the Model I is permanently enabled.

Each of the eight outputs has a status indicator L.E.D. that signifies an activated relay. A relay that is activated will have its normally open (N.O.) contacts closed. Contact closure can be verified with an ohm-meter or continuity tester if desired.

Turn ON relay 0 by entering the following statement:

```
OUT 0,1
```

You should hear a relay click and the L.E.D. next to relay 0 should light, indicating that output relay 0 is energized. Now turn on output relay 1 by entering the following statement:

```
OUT 0,2
```

Relay 1 should now be energized. Try turning on relay 2 with the statement:

```
OUT 0,4
```

Continue testing all 8 relays in the same manner. Activating more than one relay at a time is quite simple also. To turn on relays 0 and 1, add the data values of both (1 + 2 = 3):

```
OUT 0,3
```

Both relays should energize. The following statement will turn on all 8 relays as it is the sum of all 8 data values:

```
OUT 0,255
```

To turn off all outputs use:

```
OUT 0,0
```

TESTING THE INPUTS

Inputs from the Interfacer 80 to the TRS-80 use the Level II Basic INP (0) statement. All unconnected inputs will read as high or ON. By connecting one or more of the inputs to ground, you cause those inputs to read as low or off (logical 0).

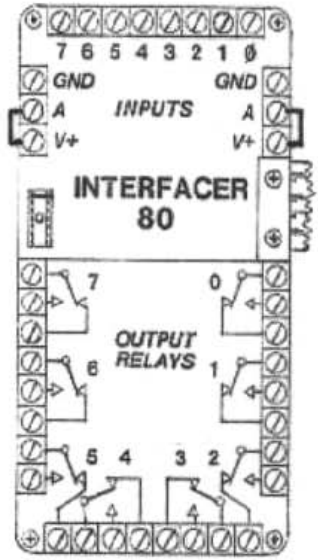
The Interfacer 80 has two sets of terminals marked "V+" and "A". Before proceeding with testing, it is necessary to place a short jumper wire between the "V+" terminal and the "A" terminal above it. Do this for both sets of "A" and "V+" terminals.

Use the following program for testing the Interfacer 80 input section (Model I users may eliminate line 20):

```
10 CLS
20 OUT 236,16
30 X = 255 - INP(0)
40 PRINT @ 0,INP(0)
50 PRINT @ 0,X
60 GOTO 30
```

Enter the above program then type RUN and press ENTER. The TRS-80 will show a continuous readout of the input status of the Interfacer 80's 8 channels. The expression 255-INP(0) in line 30 "inverts" the reading by subtracting the input from 255. We invert for convenience. Remember that any unconnected input floats high. Without inverting, an Interfacer 80 with no connection to its inputs will return a value of 255.

This program displays a direct readout of any input which is "low". A value of 8 displayed on-screen means that input 3 only is low. A 12 indicates that inputs 2 and 3 are low. (12 is the sum of the data values for inputs 2 and 3 = 4 + 8)



OPTICALLY-ISOLATED INPUTS

Each of the 8 inputs on the Interfacer 80 is equipped with an individual opto-isolator. This means that there is actually no electrical connection between the Interfacer 80 circuitry (and therefore the TRS-80) and any input. There are three major advantages to this feature:

- Ground loops between the computer and the system tied to the computer through the Interfacer 80 are eliminated.
- The computer is protected against potentially harmful faults and surges from external circuitry.
- Electrical noise created by externally connected devices is isolated from the Interfacer 80 and TRS-80.

Since the Interfacer 80 inputs are optically-isolated, they will behave somewhat differently than standard TTL inputs that you may be familiar with. An opto-isolator is a light emiting diode and a photo-sensitive transistor encapsulated together in a small package. When forward voltage is applied to, and currents flow through the L.E.D., it emits light and turns on the photo transistor. The photo transistor in turn allows current to flow through its collector-emiter and pulls down a TTL gate which is internal to the Interfacer 80. Each input terminal (0 thru 7) is connected to the cathode of one opto-isolator. With nothing connected to the input terminal, no current flows through the L.E.D. within the opto-isolator. Without light from the L.E.D. the photo transistors are in the "OFF" state. A pull-up resistor holds the input line high (@ + 5v). This is why if you type: Print INP (0) and press "ENTER" the computer will return the value 255, indicating that the 8 data lines 0 thru 7 were high when the "INP" command was executed. To read a low (or 0), a 5 to 25 MA current must be flowing thru the opto-isolator inputs (The L.E.D. side). This can be accomplished in several ways:

1 - Using a separate power supply , From 5 to 25 volts DC: Connect the positive side to the two "A" terminals. Then, if any input terminal (0-7) is connected to the minus side of the separate power supply, current will flow through it's respective opto-isolator and that input will be read as a low (0) by the TRS-80.
The "V+" and "GND" terminals are not used in this case and there should be no jumper between the "A" and "V+" terminals.

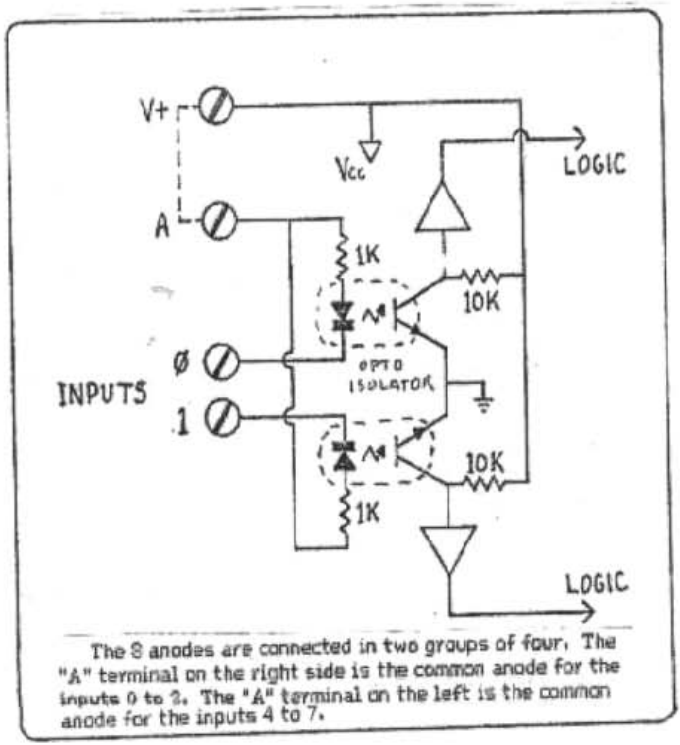
2 - Using the Interfacer 80's own power supply:
This method is particularly convenient for testing purposes, to sense switch closure, or when circuit isolation is not required.
Using two short jumper wires, connect each of the two V+ terminals to the A terminals above it. The two "V+" terminals are internally common. They are both connected to the unregulated (8 to 11 volts) supply of the Interfacer 80.
The "A" terminal on the right hand side is the common anode for opto-isolators 0,1,2 and 3. The "A" terminal on the left is the common anode of the opto-isolators of inputs 4,5,6 and 7. With this arrangement any inputs connected to ground will be read as a low by the computer. The ground (GND) terminal is the common ground for the TRS-80 and the Interfacer-80. When all inputs are connected to ground, the statement INP(0) will return a value of 0. The statement 255-INP(0) will return just the opposite- a value of 255 when all inputs are grounded.

Using method 2, try grounding each input terminal with a jumper, one at a time, while running this short program:

```
10 CLS
15 OUT 236,16   '(this line not needed for Model I)
20 PRINT@0,255-INP(0)
30 GOTO10
```

The screen will display the binary weight (data value) of a grounded input (1,2,4,8,16,32,64,128).

IMPORTANT NOTE: To protect the opto-isolators from damage caused by excessive current each one has a internal 1000 OHM resitor in series with the L.E.D.. Damage will result if the current exceeds 25 MA in any one opto-isolator. Conversely current less than 5 MA will not guarantee a low. If an external power source is used, 8 to 12 volts are optimal values, with 5 and 25 volts being the absolute minimum and maximum.



The 8 anodes are connected in two groups of four. The "A" terminal on the right side is the common anode for the inputs 0 to 3. The "A" terminal on the left is the common anode for the inputs 4 to 7.

Input Status Display Program

This program will display a chart of the present status of inputs Ø through 7 on the video screen.

```
10 DEFINT A-Z
20 CLS:L=999
30 N=INP( Ø)
40 IF N=L THEN 30
50 CLS:L=N
60 FORX=ØTO7
70 M=2↑X
80 R=N AND M
90 PRINT"INPUT";X;" IS ';
100 IF R)=1 PRINT "ON" ELSE PRINT "OFF"
110 NEXTX:GOTO 30
```

Explanation

Line 10 defines all variables as integers, si e no non-integers are required in this program. This speed program execution because integers run faster than other t es of variables.

Line 20 is an initial screen clearing and initialization of L. Setting L to 999 allows for a fall-thru line 40 since INP(Ø) cannot possibly be higher than 255.

Line 30 performs a reading of the 8 inputs and sets N equal to the present input reading.

Line 40 compares the new input value with the one being displayed. As long as they are the same no reprint is required, and lines 30 and 40 will loop. If the input changes, a fall-thru line 40 occurs and a new display is generated.

Line 50 clears the screen for the new display. It also resets L to the just-input value.

Line 60 sets up the FOR-NEXT loop which will print the 8 status statements.

Line 70 raises 2 to the power of X and sets M equal to the result. M will be used to "mask" the input so that each of the 8 input lines can be read on each of the 8 passes in this loop.

Line 80 The input value (N) is ANDed with the mask(M). A mask is a number used to block out unwanted parts so that only the wanted part will present itself. During the first pass of this loop, the input value is ANDed with binary 00000001. When two binary numbers are ANDed only the digits that are in the same respective position and are both 1's will have a binary 1 result. During the second pass of this loop the input value is ANDed with binary 00000010 so that the second digit from the right is tested. During the third pass our input value is ANDed with 00000100 so that the third digit from the right is tested. This continues until all 8 digits have been tested by 8 consecutive passes. Examples of AND masking:

Testing DATA BIT Ø

```
    01011101   INPUT VALUE (N)
AND 00000001   MASK (M)
    00000001   RESULT (R) = 1
               Therefore data bit Ø is ON
```

Testing DATA BIT 1

```
    01011101   INPUT VALUE (N)
AND 00000010   MASK (M)
    00000000   RESULT (R) = 0
               Therefore data bit 1 is OFF
```

Testing DATA BIT 2

```
    01011101   INPUT VALUE (N)
AND 00000100   MASK (M)
    00000100   RESULT (R) = 1 x 2^2 = 4
               Therefore data bit 2 is ON
```

Thus all eight bits are tested by consecutively shifting the 1 in the mask to the left for each pass and determining if the result of the AND was 1 or greater.

Line 90 prints the "INPUT X IS" for each of the 8 inputs.

Line 100 prints "ON" if the result of the AND with mask was 1 or greater. It prints "OFF" otherwise.

Line 110 is the bottom of the FOR-NEXT loop. At the end of the loop control is returned to the input read on line 30.

Automatic Telephone Dialer Program

```
 5  DEFINT A-Z
10  CLS:PRINT CHR$(23)
20  PRINT"* AUTOMATIC TELEPHONE DIALER *":PRINT:PRINT
30  IF B$="Y"THEN PRINT"RE-DIALING:";A$:GOTO50
40  A$=" ":INPUT"PHONE #";A$
50  PRINT:INPUT" PICK-UP PHONE. PRESS ENTER WHEN READY";R$
60  D=LEN(A$)
70  FOR N=1 TO D
80  P$=MID$(A$,N,1):IF ASC(P$)<48 OR ASC(P$)>57 THEN150
90  P=VAL(P$):IF P=0 THEN P=10
100 FOR G=1 TO P
110 OUT0,1:FOR T=1 TO 20:NEXT T
120 OUT0,0:FOR T=1 TO 20:NEXT T
130 NEXT G
140 FOR T=1 TO 200:NEXT T
150 NEXT N
160 PRINT:PRINT"> DIALING COMPLETED"
170 PRINT:INPUT"SAME # (Y/N) ";B$
180 GOTO 10
```

Explanation

The 'Automatic Telephone Dialer' program will automatically dial any telephone number entered. The program incorporates a re-dial feature which can be very useful for getting through to numbers that are often busy.

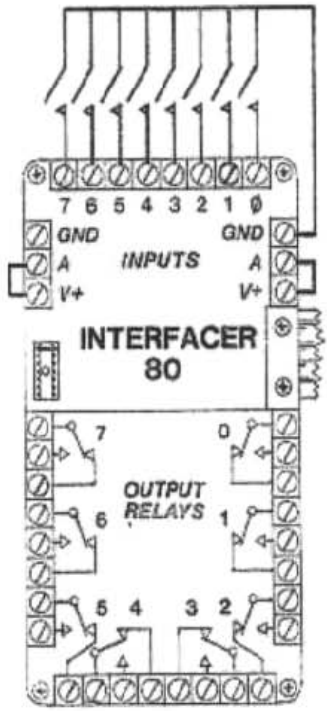
Using a pair of wires, connect the Interfacer relay 0, normally closed contacts in series with either side of the pair leading to your telephone. The most convenient place to series-connect into your telephone line is at the 42A telephone block which is usually mounted on the floor molding.

Be advised that your local telephone company may have regulations regarding the connection of foreign devices to it's telephone lines. Officially, we must advise that you contact them before making any connections. They may insist on having you lease a coupler from them.

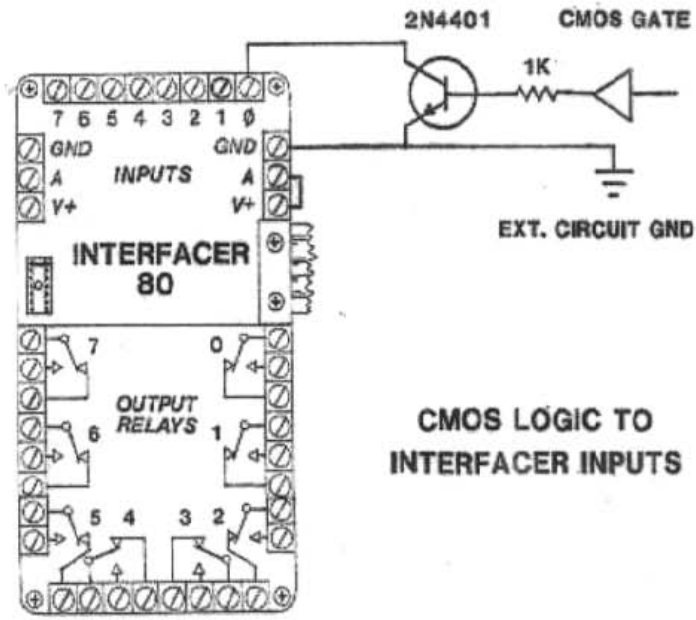
Once you have entered and run this program, it will request that you input a telephone number. You may enter a phone number of any length, either with or without spaces, hyphens or parenthesis. The entered phone number cannot contain letters of the alphabet, however. You may enter the number (800)123-4567 as 800-123-4567 or as 8001234567 or as (800)123-4567 or as 800 123 4567. The format does not matter.

After typing in the telephone number, press "ENTER". The computer will instruct you to pick-up the telephone. Wait for dial tone, then press "ENTER" again. At this point the computer will proceed to dial the entered phone number. If you are not able to get through on the first call, use the re-dial feature by entering the letter Y when asked "SAME # (Y/N)?".

This program could easily be expanded. You may wish to set up an array containing the phone numbers that you most frequently dial. You could arrange your program so that you only had to type in a name or the initials of the party to be called. The computer would find and dial the number for you.



EXTERNAL SWITCHES AND CONTACTS



CMOS LOGIC TO INTERFACER INPUTS

Electrical Noise Considerations

Interference from electrically noisy devices may cause program errors and erratic operation in both the Interfacer 2 and the TRS-80. Noise from external relays, motors or switched transformers can couple into the data buss and cause operational problems. Below is a list of suggestions which will help eliminate such problems.

1. When switching DC inductive loads from the relay outputs, connect a diode across the load in a reverse-bias fashion to absorb coil kick-back spikes. This may be necessary when driving DC relays, solenoids or motors.

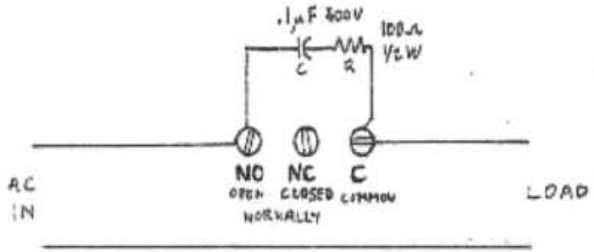
2. For AC inductive loads such as motors, use a .1 microfarad capacitor and/or an MOV with a rating of 1.6 times the AC voltage. Connect <u>across</u> the load.

3. For switching heavy loads, use a second relay driven by the Interfacer 2's relay.

4. Keep input and output lines as short as possible. Use twisted pair for medium runs and shielded cable for longer runs. It may be helpful to place .01 microfarad capacitors at both ends of the cable. Connect the capacitor from ground to the input or output.

IMPORTANT

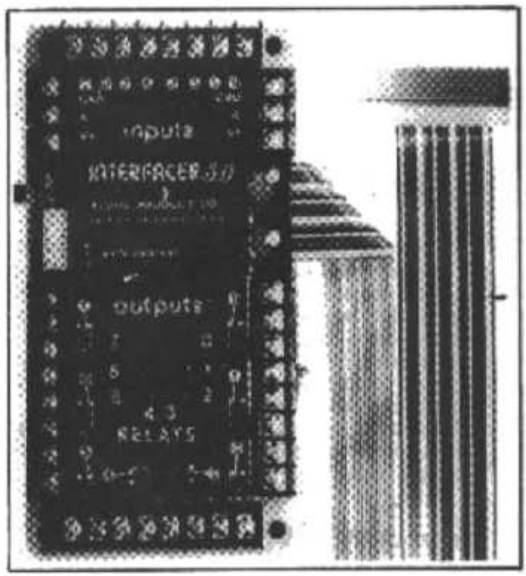
IF YOU USE THE RELAY CONTACTS TO SWITCH A 115 VOLTS LOAD, INSTALL A "SNUBBER" NETWORK (see drawing) TO PROTECT THE CONTACTS AND TO PREVENT ELECTRICAL NOISE FROM COUPLING BACK TO THE COMPUTER.



INTERFACER 80

Input / Output Interface for the TRS-80

Model I and Model III*



Interfacing...

The ability to both sense and control that which is external to the microcomputer opens to the user a whole new dimension for exploration and practical utilization. Applications range from model railroad control to energy management, from laboratory experimentation to automated industrial control.

Interfacer 80 is a versatile Input/Output interface module, designed specifically for the Radio Shack TRS-80 Microcomputer (Model I & III*). 8 input channels and 8 output relays afford TRS-80 users a vast array of new application possibilities.

Interfacer 80 is the key to interfacing to the "real world". It was designed with convenience and simplicity of operation in mind. Output relay control and input reading is accomplished by simple BASIC language OUT and INP statements. INP and OUT operations can be performed at a rate of up to 200 per second in BASIC, fast enough for most requirements.

The Inputs...

The 8 input channels are extremely versatile. Conveniently provided on screw terminals, they can be used to sense contact closure or the presence of voltage (voltage/no voltage condition). Each of the input channels is protected by it's own opto isolator which serves as a buffer allowing a wide range of voltages to be sensed directly and safely. Opto isolators provide a high degree of protection. Ground loops are eliminated and electrical noise immunity is improved.

The inputs are read quite simply by executing the BASIC statement INP(x), where x equals the value of the jumper selected port. The computer returns a numerical value containing the current status of all 8 input channels.

The 8 channels can be used to individually sense 8 separate external circuits or, several channels can be grouped in order to read words or codes such as Binary Coded Decimal (BCD) or 8-bit bytes.

Applications...

- Climate Control, Energy Management
- Automated Industrial Control
- Building and Home Security
- Lighting Control (commercial, residential, theatrical)
- Scientific Research, Laboratory Data Logging, Bio-function Monitoring
- Psychological/Behavioral Experimentation
- Hobbiest (model railroad, radio control)
- Solenoid, Stepper Motor and XY Control
- Photographic Exposure Control, Timing
- Automatic Testing Systems
- Intelligent Remote Control
- Systems for the Handicapped
- Timing, Sequential Switching

The Outputs...

There are 8 latched outputs. Each is a single-pole, double-throw relay with contacts provided on screw terminals for ease of connection. Eight L.E.D.'s give clear indication of relay status. Relay outputs can be used to drive solenoids, lamps, tone generators, motors, sirens, machinery or anything else that is controllable electrically or electronically. The TTL latched outputs are accessible should you desire to connect to external logic.

*Bus converter required for Model III. See specifications.

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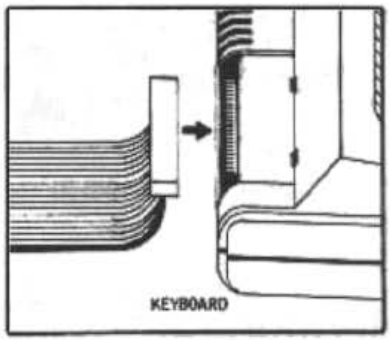
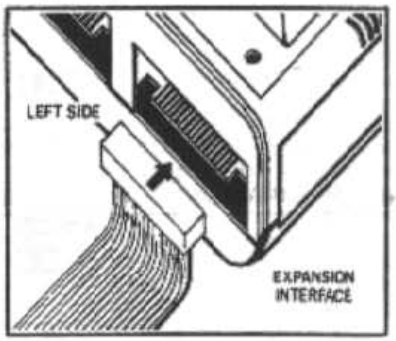
Output relays are controlled by simple BASIC "OUT port, value" statements. Any combination of relays on and relays off can be accomplished by a single OUT command—a very handy feature. Relay command is fast and simple.



User's Manual...

An extensive User's Manual covers the basics as well as more advanced aspects of interfacing. It explains in detail the operation of the Interfacer 80 and illustrates exactly how it may be put to use. Several programs are included, some discussed step by step for the user's understanding. Useful application programs such as "External Digital Keypad Access" and "Automatic Telephone Dialer" are included.

We also include straightforward technical information and diagrams for experimenters wishing to design their own applications.



System Expansion...

The port address that Interfacer 80 operates on is jumper selectable. This means that Interfacer 80 may be used in conjunction with any other TRS-80 accessories. Up to eight Interfacer 80's may be used on a single TRS-80, thus providing as many as 64 independent inputs and 64 independent relay outputs. Our Expandabus series of bus extender cables allows for connection of multiple devices on the TRS-80 bus.

Interfacer 80 comes completely assembled, tested and ready to use. Power supply, connector/cable and Manual are included.

Specifications...

Inputs:	8 optically isolated, 4VDC min., 20VDC max. Current: 5mA min., 20mA max.
Outputs:	8 single-pole, double-throw (sodt) relay contacts: 2A, 125V max.
Power:	AC adaptor supplied: 117V, 60Hz/9VDC, 200mA AC power: 5W max.
Port:	Jumper selectable address
Physical:	4¼" x 7½" x 1¾" H, 2 lbs. shipping wt.
Connection:	15" cable and connector are supplied. Connects directly to Model I TRS-80 via edge connector on rear of keyboard or to Expansion Interface (left side panel, right of printer port). For Model III TRS-80, a bus adaptor is required (Alpha Products MOD III/I BUS CONVERTER)
Price:	$159.00 + 2.50 shipping & handling. Model III users add $39.50 for MOD III/I BUS CONVERTER.

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